REMARKS/ARGUMENTS

Reconsideration of this application is requested. Claims 18-22, 24-29 and 31-37 are in the case.

I. CLAIM OBJECTIONS

Claim 19, 21 and 22 objected to because of the informalities noted on pages 2 and 3 of the Action. Claim 19 is objected to in view of the phrase, "disfigurements of the substrates are preoccupied with the filler". The Action asserts that a disfigurement of a substrate can not be preoccupied, (i.e. worried, anxious, or inattentive).

In response, the term “preoccupied” (according to Chambers English Dictionary) includes the meaning “already occupied”. It is clear therefore that the disfigurement of the substrate could be “already occupied” by the filler.

Claim 21 is objected to in view of the phrase, "a an electroless". This has been corrected.

Withdrawal of the objections is respectfully requested.

II. THE FORMAL REJECTION

Claims 18-22, 24-29 and 31-35 rejected under 35 U.S.C. §112, second paragraph, as allegedly indefinite for the reasons outlined on pages 3-6 of the Action. The rejection is respectfully traversed.

Referring to claim 18, the term “post-“ in “post-processing” refers, for example, to the processing being after the plating step, not necessarily after any drying step. In the description of Example 1 (page 9 lines 2 to 4 of the specification), for example, a drying

step is a part of the "post-processing" and is carried out before the partial removal or reduction in volume of the pore fillers.

At page 5, lines 24 to 28, referred to on page 3 of the Action, the first sentence includes a discussion in general terms of removal or reduction in volume of the pore fillers. The second sentence gives an example of a procedure including the removal or reduction in volume of the pore fillers. In that second sentence, a discussion of drying of the membrane is included, the drying being subsequent to the formation of the membrane earlier described in paragraph 4, lines 17 to 23. No indefiniteness arises, therefore, with regard to claim 18.

Claim 19 has been objected to in view of the term "preferably". This was deleted from claim 19 in the prior response dated December 24, 2009.

Claim 33 has been objected to because of the expression "the heating in step 6 is done by.... calcination". In response, claim 33 has been amended to state that "the post-processing includes calcination or pyrolysis of the pore fillers".

Claims 28 and 29 are objected to as encompassing broader and narrower language. In response, both claims have been amended and the deleted subject matter is presented in new dependent claims 36 and 37. No new matter is entered. Withdrawal of the formal rejection is respectfully requested.

III. THE OBVIOUSNESS REJECTION

Claims 18-22, 24-29, and 31-35 rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Kawae *et al.* (US 6,066,592) (Kawae) in view of Blaha (US 3,353,982) as evidenced by Wells (US 3,918,927), Mundshau (US 2003/0183080) and

Jung *et al.* (US 3607787A) (Jung) (it is assumed the reference to Yoshiyuki at page 7, line 5 of the Action is an error). The obviousness rejection is respectfully traversed.

As claimed, there is provided a process for the preparation of a two layer metal palladium or palladium alloy composite membrane consisting of a porous substrate support and a palladium or palladium alloy membrane. The process comprises: 1) rinsing/washing and drying the porous substrate support, 2) treating the porous substrate support with a pore filler in order to decorate the pores of the support and the disfigurements of the substrate surface, 3) sensitizing and activating with a palladium solution the decorated substrate support, 4) plating the resulting support with a palladium solution to form the two layer composite membrane, 5) drying, and 6) subjecting the resulting composite membrane to a post-processing where the pore fillers residing in the pore-channels of the porous substrate are partly removed or reduced in volume through heating.

The invention provides a procedure for preventing the penetration of metal into the pores of the porous support during the deposition of the metal from electroless plating baths, where the auxiliary substances (pore fillers) are not completely removed after deposition of a metal layer, but transformed into porous substances through thermal treatment. This is achieved by preoccupying the pores of the support with the claimed modifiers prior to the deposition of the metal layer, which are transformed into a porous filler within the pores of the support by thermal treatment after the layer has been deposited. During the heat treatment, the pore filler partly decomposes and releases gaseous products, e.g. CO, CO_2, or H_2O, which can easily escape from the porous support structure without causing damage to the deposited metal layer.

It is to be noted that these gaseous molecules are also typical components of the H_2-containing gas streams, from which the H_2 is to be separated by means of the composite Pd membrane at temperatures up to 700°C. It is an important characteristic of the present invention that the auxiliary substance at least partly stays behind in the support of the finished composite membrane and that the pore structure, the pore size, and the pore volume of the support are altered after deposition of the metal layer. In particular, the pore size of the support pores modified with the porous filler in the finished composite Pd membrane is in general smaller than the thickness of the deposited Pd layer.

The inventors have thus identified that a two-layer metal composite membrane can be fabricated in which the pore fillers are not completely removed after deposition of a metal layer, but are processed through thermal treatment such that their size within the pores of the substrate is reduced. Without being bound to any particular theory, it is thought that in examples of the claimed invention, the adhesion between the metal membrane layer and the porous support is not substantially compromised following the fabrication process of the present invention even after the partial removal or reduction in volume of the pore fillers. This is believed arise because, first, filler remains in and on the support after the thermal treatment and thus bonds formed between the deposited metal layer and the porous support surface remain intact. Secondly, during the transformation of the pore filler at elevated temperatures, bonds can be formed between the porous filler and the porous support in some examples which can strengthen the adhesion between the deposited metal layer and the porous support and thus improve the overall stability of the composite membrane system.

Kawae does not disclose or suggest the process as claimed. In particular, Kawae is silent on the step of the claimed process wherein pore fillers are partly removed or reduced in volume through heating after formation of the membrane (step 6).

In the gas separator of Kawae, a metal, for example palladium, membrane is provided for separating the gas. Kawae includes the step of filling the metal membrane material into the pores of the substrate. Thus, in the Kawae membrane, the material filled in the pores of the substrate provides a function in the resulting membrane product, namely the separation of the gas.

In light of this, there would have been no motivation for one of ordinary skill to carry out a treatment which would remove or reduce in volume the material in the pores. This is because the pore filler in Kawae is added for the function of the resulting gas separator.

The suggestion in the Action that the skilled person would consider replacing the gas separator metal filled into the pores of the substrate of Kawae with a calcium carbonate material (referring to Blaha) is not correct. As indicated above, in Kawae, the metal gas separator is provided in the pores to give the membrane product its function of separating the gas. As stated in Kawae (col. 4. lines 15 to 19), in some examples of Kawae, "the metal 3 for separating the gas present in the porous substrate 2 functions to separate the gas, and hence such a gas separating film 4 as shown in Fig 1 is not essential". Based on this, the skilled person would not have been motivated to change the process of Kawae to include anything in the pores other than the gas separating

metal described in Kawae, because to do so would remove the functional gas separating component of Kawae.

Even if the skilled person had considered filling the pores of the substrate of Kawae with a material other than the metal as described (it is believed this would not have occurred for the reasons noted above), there is nothing in Kawae which would have led the skilled person to fill the pores with calcium carbonate, and then carry out a process to partly remove or reduce in volume the pore fillers, as required by the presently claimed process. As Kawae makes clear (col. 3, lines 5 to 8): "in the gas separator 1 of the present invention, the metal 3 for separating the gas is filled into the pores 5 **to close them**, so that the material gas is prevented from leaking into a purified gas" (emphasis added). The skilled person would have understood from Kawae that the pores should be "closed". There would therefore have been no motivation to carry out a treatment which would partly remove or reduce in volume the pore filler in the substrate.

Referring to the comment on page 9, first paragraph of the Action, contrary to this, the skilled person would not have considered replacing the metal gas separator pore filler of Kawae with calcium carbonate, because the skilled person would have realized that calcium carbonate would not be suitable to provide the features taught by Kawae to be essential of the pore filler, namely that it be a metal gas separator, and also (having reference to the passage at col. 3, lines 5 to 8 of Kawae, discussed above) will close the pores. For the same reason, the skilled person would not have been motivated to process the pore filler such that it is partly removed or reduced in volume in the substrate.

There is nothing in Blaha regarding partly removing or reducing in volume a pore filler, and no suggestion in Blaha of heating the pore filler to partly remove or reduce it in volume. In Blaha, the calcium carbonate is said to be **removed** by a leaching treatment. Blaha provides no suggestion of partial removal of the calcium carbonate.

In light of the above, even if the skilled person had considered including calcium carbonate of Blaha in the porous substrate of Kawae (it is believed this would not have occurred at least for the reasons given above), there is nothing in Blaha or Kawae, taken singly or in combination, which would have led the skilled person to partially remove or reduce in volume a pore filler by heating as required by the presently claimed invention.

The Action refers to Drost as discussing filling pores of a substrate and subsequently removing the pore filler. Drost discloses that the pore filler is **removed**, in this case being chemically dissolved. There is nothing in Drost to suggest a heat treatment on the pore filler as presently claimed and, in particular, nothing in Drost to suggest that the pore filler could be partially removed or reduced in volume as presently claimed.

Similarly, there is nothing in Mundschau or Jung to suggest a process of preparing a two layer metal composite membrane in which pores of a porous substrate are filled with a pore filler which, after forming of the composite membrane, is subsequently partially removed or reduced in volume by heating as presently claimed.

Wells is cited because of an alleged disclosure of conventional plating processes to produce a plated product having good adhesion of the metal plate thereto. Wells clearly does not cure the above-noted deficiencies of the other cited art.

Withdrawal of the obviousness rejection is respectfully requested.

Favorable action is awaited.

Respectfully submitted,

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